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Report of the Working Group on Large Marine Ecosystem Program Best Practices (WGLMEBP)

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ICES International Council for the Exploration of the Sea

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Executive Summary

The first meeting of the ICES Working Group on Large Marine Ecosystems Best Practices (WGLMEBP), co-chaired by Michael O'Toole and Jan Thulin, was held at the IOC/UNESCO headquarters in Paris on 6–7 July 2010. It was attended by 25 members representing senior scientists and project managers from several Large Marine Ecosystems (LMEs) in Africa, Asia, Latin America and northern Europe, ICES, IOC, NOAA, FAO, GEF:IW LEARN and a number of international institutions from Norway, Sweden, UK and Germany.

The objectives of the Working Group meeting were to assess the current achievements of some LME projects worldwide and to identify, review and synthesise best assessment and management practices. The Working Group also highlighted challenges of LME management in terms of quality science, training and capacity building as well as information sharing and outreach. One of the main points for discussion was on how best ICES could link with LMEs and offer scientific support, advice and expertise from its extensive experience in coordination of marine science in the North Atlantic.

Assessment and management methodologies in LMEs use ecosystem based management principals developed through a transboundary TDA and SAP process. The adoption of the five modules of productivity, fish and fisheries, ecosystem health and pollution, socio-economics and governance enable the practical implementation of this science driven approach. The Benguela Current, Baltic Sea and Yellow Sea LMEs are good examples of an integrated approach to marine ecosystem management.

Cost effective monitoring of status indicators for ecosystems, valuation of goods and services, incorporating socioeconomic considerations and governance practices are all part of LME assessments. In addition, integrated coastal management (ICM), climate change impacts and adaptation and marine spatial planning also need to be incorporated into ecosystem based assessments.

Case studies of five LMEs were presented (Benguela Current, Baltic Sea, Guinea Current, Agulhas Somali Current, Gulf of Mexico) outlining the development and implementation of the projects and best practices in application of the five modules in assessment of the ecosystems. Key challenges were also identified in building links between science and governance, addressing training and capacity building needs and ensuring deliverables were relevant to coastal communities and regional stakeholders.

The ICES Strategic Science Plan (2009–2013) with its revised mandate is flexible and multi-disciplinary with a horizontal approach in developing strategic links with new partners and programmes such as LMEs.

ICES has much to offer LMEs including long track record in marine science (over 100 years), it's extensive scientific and expert working group networks, strong science peer review and it's integrated ecosystem assessment methodology and frameworks. It can provide specialized training in key areas , strengthen research cooperation and bring LMEs into mainstream science.

LMEs bring to ICES the large global network of over 100 countries working on integrated ocean management in 64 LMEs. They use a standard methodology i.e. TDA and SAP as well as 5 modules which address both science, socio-economics and governance aspects of ecosystem based management.

Specialised training courses and decision support tools are available to LMEs from various sources including ICES, IOC, FAO, ODIN-Africa, IODE, International Ocean Institute (IOI), and other institutions and universities

The new GEF IW:LEARN portfolio will improve transboundary water management in large marine ecosystems and their coasts and will promote good practice for nutrient reduction, marine institutional legal framework building and the development of methodologies for transboundary water assessment. The recently launched IW: SCIENCE project will assess the science and outputs from global LME projects for inclusion into a database.

The SCICOM Regional Seas Programme, e.g. Baltic Sea, North Sea, Bay of Biscay and NW Atlantic is comparable with other global LME regions. They have expert groups for integrated ecosystem assessments coupled with economic, ecological and risk evaluation management tools which could support ecosystem based management in LMEs.

Further research is needed to interpret changes taking place in food webs of marine ecosystems and to determine within various LMEs which indicators should be selected to reflect trends and realities within the systems.

The Co-Chairs were tasked with various duties in preparation for the next meeting which would be held in Paris in July 2011 immediately following the 13th LME Consultative Meeting.

1 Welcoming and opening of the meeting

The first meeting of the ICES Working Group on Large Marine Ecosystems Best Practices, Co-Chaired by Michael O'Toole and Jan Thulin, was hosted by the Intergovernmental Oceanographic Commission (IOC) at the IOC/UNESCO Headquarters in Paris, France on 6–7 July 2010. The meeting of the WGLMEBP was formally opened with a welcoming address by Gerd Hubold, the General Secretary of ICES. He pointed out that ICES has a long and successful history in ocean research and the coordination of marine science in the North Atlantic and during the last decade has extended its area of expertise beyond fisheries to include ecosystem assessments and governance issues. The organization has a wide range of expert groups that provides knowledge and information to inform decision making in an unbiased, independent and non political manner. ICES has strong links to other intergovernmental organizations and global projects in the northern hemisphere such as PICES, the IOC and GLOBEC.

2 Introduction and Background

Michael O'Toole provided an introduction to the agenda and outlined the background to the formation of the WG and the specifics of the terms of reference. He emphasized the importance of protecting the investment already made by the Global Environment Facility (GEF) in LME projects worldwide in developing effective and efficient implementation plans, critically reviewing the LME principals and the science and demonstrating measurable progress in sustaining marine and coastal ecosystems. He highlighted the current achievements and some of the difficulties experienced with global LME projects including lack of process to identify, review and synthesise the best assessment and management practices, difficulties in exchanging information and lack of analysis and integration of scientific findings from LME projects. In addition, he identified the need for scientific capacity of countries to be strengthened to implement adaptive ecosystem based management. He also pointed to the need for coordination across LME's in terms of sharing experiences, cost effectiveness, technological improvements, data and information management, agreed and measurable indicators and benefits as well as effective outreach and linkages.

Jan Thulin made a brief intervention and welcome to members of the Working Group to this historic first meeting between LME practitioners and ICES. He presented a slide on Ken Sherman's achievements in developing and implementing a modular approach to ocean governance through the LME's and made a formal announcement of his award of the "Goteborg Prize for Sustainable Development" which by some is considered the Nobel equivalent in the environment field.

3 Presentations on LMEs

Ken Sherman's presentation on assessment and management methodologies in LMEs indicated that the world was moving towards ecosystem based management and the five modules of productivity, fish and fisheries, ecosystem health and pollution, socio-economics and governance enable the practical implementation of this science driven approach. He pointed to a number of LME's including the Benguela Current and the Baltic Sea where the five modules underpinned by evident-based science were being used to manage the marine and coastal resources and the environment/ He highlighted the Yellow Sea LME as a successful case study where the modular

approach allowed flexibility in the way the countries can shape their own activities and move from science into management. Actions have already led to best practices in producing a Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP) and the development of an integrated multi-trophic aquaculture methodology. China and Korea have been developing a framework of cooperation together in the Yellow Sea LME to improve water quality management, tackle harmful algal blooms and integrate aquaculture and marine spatial planning. The framework is putting in place a target to rebuild fish stocks and to reduce fishing effort by 30% in terms of fleet capacity by 2020 with the private sector making a considerable investment. Both countries plan to establish a Commission by the end of 2010 to jointly manage the Yellow Sea LME.

Gotthilf Hempel highlighted the need to meet training and capacity building requirements in Ecosystem Based Management (EBM) in LMEs and that quality marine research was essential to provide scientific evidence based advice. He stressed the importance of adaptive management and how the indicators from the five modules were a key part of the international assessments. The Global Environment Facility (GEF) spent a lot of funds developing TDAs and SAPs in LME to design and implement integrated marine environmental and resource management assessments. These plans in recent years also focus on integrated coastal management and climate change impacts and adaptation. Much information existed for LME biological resources and further improvements need to be made in relation to assessment and monitoring of indicators so that they can deliver greater power to demonstrate trends which are cheap and effective to measure. Indicators of socio-economics, climate change and governance as well as the values of goods and services also need to be kept in the forefront in managing large marine ecosystems. He also stressed that LME assessments should be comparable across systems in order to draw on lessons learned and best practices. The LME Community of Practice needs greater communication on science outcomes between researchers and more established links between science, economics and governance. The existing global network of LME researchers offer a framework for building and coordinating mechanism of international ocean governance based on the 5 modules. Capacity building and learning by doing as well as through specialised training was needed which could be supplied by European sciences to provide a good base. This could be greatly enhanced through twinning of LMEs, specialised training, electronic fora and through IW:LEARN training projects.

It was pointed out that the ICES Working Groups which represent LMEs in the northern European area could have a lot to offer the existing global LME network of projects. In particular, the Baltic Sea and Barent Sea LMEs in northern European waters have a lot of useful lessons and methodologies for ecosystem based assessments. Although over 100 years old, inter-governmental and European focused, he felt that ICES would benefit a lot from close ties with the global LMEs and strengthen its own stature. He called for a Secretariat to be established in ICES in Copenhagen to coordinate all LME /ICES related activities and to ensure best practices, organise specialised workshops, prepare web-based communication and outreach and make information available to public and private partners. He concluded by saying that the Working Group should aim to come up with a win/win situation linking the LME and ICES approach.

Michael O'Toole presented a case history on the development and implementation of the Benguela Current Large Marine Ecosystem Programme (BCLME) between 1997 and 2007 and the subsequent establishment of the Benguela Current Commission. The GEF funded Programme, involving Angola, Namibia and South Africa followed

the GEF guidelines of first producing a TDA followed by a SAP and jointly addressed ocean management issues under the five LME modules of productivity, fish and fisheries, ecosystem health and pollution, socio-economics and governance. Over 100 projects were completed covering a wide variety of thematic areas which included developing and implementing an ecosystem approach to fisheries management, environmental impacts of offshore oil and gas exploration and production, marine diamond mining, coastal zone management, fisheries socio-economics, climate change and oceanographic modelling and forecasting. Much of the scientific research was undertaken by the BENEFIT programme which investigated fisheries, marine biodiversity, oceanographic processes, top predators and trophic interactions within the Benguela ecosystem.

The Benguela Current Commission was signed by the three countries in 2006 which provides for a broad mandate to implement an ecosystem approach to ocean governance in the Exclusive Economic Zone waters of the three countries.

Jan Thulin provided a brief history of the Baltic Sea LME project which received PDF Block B funding from the GEF and followed the process of TDA and SAP development. This initial project became the Baltic Sea Regional Project (BSRP) which had marine, coastal and land based components with a final budget of USD 16 million of which USD 5.4 million came from the GEF. Funding was used to upgrade laboratories and improve assessments, science and coordination mainly within eastern European partner countries through a joint comprehensive management and assessment programme. It ended in 2007. Some of the outcomes of the BSRP includes the development of indicator based assessments, coastal fish monitoring, phyto-benthos monitoring and use of ships of opportunity to measure productivity and plankton biomass. Parallel to and in cooperation with the BSRP the EU-funded BONUS Era-Net was developed and implemented. BSRP/ICES was in charge of producing the Science Plan for the Baltic Sea on which the subsequent project BONUS+ is based and implemented. This project, also based on the LME concept, comprising 16 projects with a funding of €23 million runs from 2008–2013. This project in turn will be followed by the Joint Baltic Sea Research programme BONUS-169 with an anticipated funding volume of about €100 million (2010–2016). The BONUS programmes have developed good practices in a number of areas and have a high status among research scientists and managers in the region. ICES is represented on its Advisory Board and has a signed MoU with the programme.

Christian Susan provided an overview of the Guinea Current Large Marine Ecosystem Project (GCLME) which represents 16 West African countries and links with the Canary Current LME in the north and the Benguela Current LME in the south. It is a highly productive marine ecosystem with ocean and coastal regions, lagoons, mangroves and estuaries all rich in biodiversity and living marine resources. There is heavy over-fishing throughout the region especially by foreign vessels. Over 300 million people live within 200 km of the coast with many relying on fish from the sea for food security. There are many different languages and some constraints to integrated development including regional disparity, poverty, fragmented data sets, little sharing between neighbouring states, limited capacity, and difficulties with property rights. Regional workshops are expensive to hold i.e. €60 000 and must be well planned to be cost-effective. The main objectives of the GCLME project is to rebuild and sustain fisheries and restore degraded habitats. The TDA has been completed but because of the amount of countries involved, the SAP is still very generic. National Action Plans (NAPs) are therefore needed to develop concrete actions and commitments on behalf of national governments and to strengthen baselines and

incremental costs. The development of NAPs are currently underway and their implementation are expected to lead towards sustainable fisheries and the restoration of stocks in the GCLME countries. Once the NAPs are completed, a donor conference will be held to lever funding to support national actions with funding from the GEF being made available to the countries at a ratio of 1:3. The vulnerability of the GCLME to climate change also needs to be assessed and effective adaptation mechanisms developed to address the anticipated impacts. There are a number of countries very vulnerable to sea level rise.

Antonio Diaz de Leon made a presentation on the Gulf of Mexico LME project and highlighted the development of integrated land and sea use planning. He stressed the importance of interacting with users in planning areas for development and to promote marine spatial planning in a ordered way. The Gulf of Mexico region which include the US, Mexico and Cuba has good and services valued at about $230 billion. Mexico has a Committee representing many Ministries to oversee land/sea use planning and to review projects through technical committees. Making a regulatory framework for marine spatial planning is a key objective of the Gulf of Mexico LME which would include archival best information on GIS and incorporating data from marine tourism, energy, conservation, artisanal and offshore fisheries and security. The GoM committee for Land and Sea Use Planning (LSUP) has now characterised the marine and coastal areas according to bathymetry, hydrodynamics and biological zones. During the three month consultation phase, useful lessons were learned on what needed to be done. Among the most important were the need for political will; bringing in key sectors from the beginning; confidence, cooperation and consensus and building capacity; transparency; communication; use of valuation of ecosystem and the use of best technologies to support decision making and developing a network of experts including academics, consultants and NGO's.

David Vousden provided an overview of the Aguhlas Somali Current LME Project which comprises three partners, WioLab, SWIOFP and the ACLME and is based on the five modules. The productivity module assesses satellite imagery and measurements of phytoplankton and zooplankton productivity. Fisheries activities include coastal artisanal fisheries and offshore blue water fisheries and well as data collection on fish species biodiversity on seamounts. Ecosystem health and pollution studies investigate heavy metals in the marine environment, PoPs, invasives and vulnerable species and habitats. The socio-economic and governance module covers valuation of goods and services, D-LIST demonstration sites and workshops in coastal communities and assessment of government policies, development of a Strategic Action Programme (SAP) and stakeholder participation. Capacity building is an important component of the project and 21 scientists from the region have been trained in ecosystem assessment including specialised workshops on alien invasives and taxonomy of zooplankton. Communications and media is also an important component of the project where maximum outreach to and feedback from stakeholders is considered a priority. Deep-sea oceanography and the deployment of Atlas moorings with temperature and current sensors form a key part of the project with research yielding high resolution mapping, rare and unrecorded species and new information on deep-water corals and the ecology of seamounts. Research cruises have been carried out mainly by the *RS Fridtjof Nansen* although the South African vessel *R.S. Algoa* has begun to take an active part in the research in the region. Access to ocean regions north of 12 degrees south is now difficult due to piracy but new ways to collect data are being examined including use of ships of opportunity and remote sensing. One of the key challenges of the ACLME project is to build links between science and gov-

ernance and make the deliverables of relevance to coastal communities and regional stakeholders.

Sheila Heymans presented an outline of the IW-Science project and its objectives which is to enhance the use of science in the International Waters projects to improve project results. It is designed to inform GEF 5 and covers rivers, land, LMEs and open oceans. The Open Ocean and LME Working Group comprises 14 people and 51 projects. One of the key aims is to determine what are the critical emerging science issues on GEF projects. Much of the work consists of data mining and archiving all science reports in order to produce a synthesis. This has been done through questionnaires and a technical workshop (Macau). Indicators to support science will also be assessed and how adaptive management is used in the local and wider community and to communicate science. Some of the critical science issues identified so far include invasives, sustainable fisheries, eutrophication and IUU fishing with regional scale drives being mainly sea food production, population growth, international shipping and energy costs.

Hein Ruin Skjoldal discussed the Barent Sea LME which is one of 17 Arctic high latitude large marine ecosystems. He reported on an integrated management plan for the Barent Sea including consultative activities to identify vulnerable resources and valuable areas as well as sectoral impacts such as petroleum, shipping, fisheries and other external pressures. Boundaries have been agreed between Russia and Norway and joint resource management for capelin, polar cod and herring is being implemented through a Fisheries Commission. A joint fisheries and environmental status report is produced each year. The importance of the recently enacted EU Marine Strategy Framework Directive (MSFD) was also highlighted where "good environmental status" (GES) of marine waters is a key policy objective to be achieved by 2020. ICES is providing guidance in developing indicators for GES in close cooperation with the OSPAR Convention. This Directive will be an important driver in implementation of the ecosystem approach to management of marine eco-regions. He pointed out that all marine ecosystems were highly variable e.g. the North Sea ecosystem has demonstrated regime shifts in ecosystem state from 1983–2003 and is influenced through various means of forcing moving from positive to negative anomalies and that all elements should be included in an assessment of status. He felt that too much emphasis was placed on indicators to demonstrate ecosystem status particularly when looking at the overall states of the ecosystem and changes occurring within it. Indicator frameworks rest on the assumption that there are causal chains, but these are often embedded in the food web and difficult to use for integrated assessments. Although indicators were a useful concept to applied to management, one must know how the ecosystem functions and how trophic interactions with food webs work to understand them better.

4 Presentation by ICES

Adi Kellermann discussed the 2007 ICES Strategic Science Plan which had replaced the plan produced in 2002. The Plan (2009–2013) covers 16 research topics under 3 overarching areas with ecosystem based management (EBM) forming a core activity. It has a good balance of bottom-up and top-down activities providing a strong advice structure with important linkages to other marine science networks and institutions. Thematic Area 1 "Understanding Ecosystem Functioning" includes climate change, life histories, ecosystem approach to fisheries (EAF), top predators, sensitive ecosystems and integration of surveys in support of the ecosystem approach to manage-

ment. Thematic Area 2 focuses on "Human Activities within Ecosystems" such as impacts of fishing, renewable energy, offshore oil and gas and pollution on marine ecosystems whereas Thematic Area 3 addresses "Development of Options for Sustainable Use of Ecosystems i.e. socio-economic impacts, marine protected areas, operational models, forecasting and marine spatial planning (MSP). ICES draws from an expert pool of national scientists and provides advice and reviews through expert groups and operational groups via ACOM and SCICOM.

ICES under its revised mandate strives to be flexible, multi-disciplinary and have a horizontal approach and needs to work with new partners to strengthen and form strategic links with other expert pools and programmes such as the LMEs. Within ICES, the Regional Seas Programme which includes the Baltic Sea, the Bay of Biscay, the North Sea and the NW Atlantic are comparable LME type regions within Europe. The SCICOM Strategic Initiatives comprise Climate Change, Global Stock Assessment Evaluation, Biodiversity Science and application of EAM and Coastal Zone Management/ Marine Spatial Planning (MSP). ICES also has an Operational Training Programme which includes Bayesian modelling, management and ecosystem modelling, fish stock assessment , integrated ecosystem assessment and climate change impacts. ICES also plans a training programme in Integrated Ecosystem Assessment (IEA). There are plans for establishing a project service facility designed to offer coordination and project management support to large-scale international ventures. ICES leads a coordination and support action (CSA under the EC RFP 7) to establish a long-term forum for communication and exchange of the marine and maritime research networks in the European seas (MARCOM+).

Yvonne Walther outlined the SCICOM Regional Seas Programme and its vision which is to identify and coordinate real world applications of science with a spatial interest at Regional Seas level. Its benefits include its cross cutting activities especially in relation to the achievements in the Baltic Sea. There are four regional seas – the Baltic, North Sea, Bay of Biscay and the NW Atlantic, each with multiple expert groups. They are product and advice orientated with guidelines and best practices linked strongly to the Science of ICES. It has broad stakeholder participation and is informative with strong similarities with LMEs. The Regional Seas Programme have expert groups for Integrated Ecosystem Assessments and for identifying regime shifts in fisheries and ecosystem productivity and changes in biological reference points. Ecological and economic modelling and risk assessment are coupled into management tools. It is well structures under the umbrella of ICES. The Baltic Sea LME is essentially a Regional Seas Programmes operating within a framework of an Integrated Ecosystem Assessment whereby contaminants, biological effects of pollutants, pathology and disease are monitored and the status and ecological integrity of the ecosystem is modelled.

5 Training and Capacity Building

Hashali Hamukuaya outlined the importance of training and capacity building in the Bengeula Current LME and this was identified as recurring issues in the TDA and SAP i.e. inadequate capacity to assess the Benguela ecosystem. Training and Capacity Building needs were first identified in 2004 through a strategic planning workshop. Under the Benguela Current Commission (BCC) interim agreement, the member states further committed themselves to build capacity to support decision making and that training in all its forms needed to be strengthened especially in relation to the implementation of ecosystem based management. An up-dated training

and capacity building strategic plan has been developed by the BCC in 2009 that re-prioritises regional efforts including the development of draft course contents, identifies target groups, potential trainers and service providers. The plan also promotes the need for greater student training in marine science in universities with sustainable funding mechanisms. Links have been developed with SAMS, University of Cape Town, University of Western Cape, Danish Technical University, University of Rhode Island as well as ODINAfrica and FAO courses in the ecosystem approach to fisheries (EAF).

David Vousden provided an account of the training and capacity requirements of the Aghulas Somali Current LME Project which was essentially similar to the needs identified in the BCLME and which are now being implemented as part of a strategic training plan. There is a training and coordinating group with a specific budget which takes into account those needs identified in national plans and in the SAP. Shipboard training in oceanography and fisheries is an active part of the programme and targeted courses and workshops of varying duration are also given by institutions in Cape Town (MARE) and at the University of Grahamstown e.g. Inshore ecosystem based assessments; coastal oceanography and monitoring and fish identification. Emphasis is also place on sustainability by training the trainers and also through D-LIST which seeks to build resource centres of excellence at local and community levels where science and governance issues can be integrated in a practical way.

Antonio Diaz de Leon highlighted some of the training and capacity building initiatives in the Gulf of Mexico LME ranging from coastal zone management, to various workshops on pollution protocols and monitoring to oil spill response and best practices in the CLIMARES project. Handbooks and guides have been produced but greater training through universities is needed as well as specialised courses in fisheries management, oceanography and environmental monitoring including ecosystem health. There was a real need in the Gulf of Mexico to build networks among scientists and managers and that the US and Canada play a more important and greater role.

Vladimir Mamaev presented an outline of the new GEF IW:LEARN portfolio whose objectives are is to improve transboundary waters management (fresh and ground water) and Large Marine Ecosystems and their coasts. The new portfolio also deals with promoting good practices for nutrient reduction, marine institutional legal framework building and the development of methodologies for transboundary water assessments (TWAP). The GEF IW:LEARN project also supports the new IW: Science project which will assess the science and outputs from global LME projects for inclusion into a database. It was also pointed out that IW: LEARN provided a number of services to International Waters projects and to various agencies which include:- knowledge management, targeted training workshops, inter-project learning exchanges, Community of Practice facilitation, support to Biennial International Waters Conference and outreach including information synthesis and dissemination. Other services are the provision of TDA and SAP course guidelines, project manager manuals and private sector engagement at a number of levels.

Isabel Torres de Noronha summarised support services and capacity building network of the IOC and its key capacity development principals and strategies. It assists developing countries in institutional strengthening, leadership and team building and provides various courses and training programmes to directors, managers and scientists. IOC also supplies training in the use of decision support tools, remote sens-

ing and GIS. Specialised workshop and courses on harmful algal blooms (HABs) with manuals and guidelines are also provided. Capacity development in Africa is a priority particularly through promotion and coordination of Information on Ocean Data Exchange (IODE) and ODIN-Africa where funds and support are available for training and use of coastal monitoring systems e.g. tide-gauge networks.

Wener Ekau provided an overview of some training courses available in ocean governance and resource management for senior managers from developing countries. These included the courses run by the International Ocean Institute at Dalhousie University, Canada in ocean governance, policy and law and a 2-year MSc course in regional governance in Malta. MSc courses were also offered by the Institute of Tropical Ecology as part of international studies at the University of Bremen, Germany with good examples from Namibia and Papua New Guinea. Experience from LMEs have shown that training and capacity building need and standards have to be identified from the on-set and that long-term planning and commitment is required to achieve these goals.

6 Discussions

a) Interactions between ICES and LMEs

The Working Group considered what ICES could offer the LME community and what the LMEs could offer ICES in terms of scientific cooperation, training and support. The following are the key points that resulted from the dialogue:

- ICES had much to offer the LME community with its long track record in excellence in marine science. It has an extensive scientific network with over 100 expert working / steering groups and has a strong peer review system in place. ICES has well developed links and cooperation with key global marine science initiatives e.g. PICES and its association with LMEs would strengthen the credibility of the science to support ecosystem based management.
- ICES can provide specialised training courses in fish stock assessment and ecosystem based management as well as developing and applying frameworks and methodologies for conducting integrated ecosystem assessments. These could be made available to scientists from LMEs
- ICES can bring the LME's into mainstream marine science, strengthen north / south cooperation and provide access to its Annual Science Conference. LME participants who are interested can also joint expert ICES working groups. It was also proposed that a special LME session be part of next year's ICES Annual Meeting in Poland. This would be a good way of establishing links between ICES and LME groups and comparing lessons learned in marine science and ecosystem management. It would be important that ICES welcome and support LME participants and integrate them into the process.
- ICES could also assist with access to scientific literature, expert scientific advice and peer review and supporting cooperative research and twinning between north and south in specific projects.
- ICES expertise could assist in building sustainability within the LME Community of Practice and become a strong partner with GEF IW:LEARN through providing specialised training for senior scientists and managers in LMEs.

- LME's have an immense network with over 100 countries worldwide involved in marine science and integrated ocean management using an ecosystem approach. LME project management have often closer links at ministerial level than for similar projects in Europe i.e. Yellow Sea LME, Benguela Current LME and Guinea Current LME. ICES can link into this global network and move towards a greater engagement with ocean management in developing parts of the world.
- LMEs use 5 modules and associated status indicators in monitoring of the marine and coastal ecosystem i.e. productivity, fish and fisheries, ecosystem health and pollution, socio-economics and governance. This allows for some comparability between LMEs in a number of thematic areas.
- Useful planning tools and practical methodologies have been developed by GEF for application in LME's i.e. TDA, SAP, IW:LEARN and IW:SCIENCE which have a wide application. There is good experience here and many lessons have been learned which may be of interest to ICES.
- LMEs have experience in marine science and management many types of systems ranging from tropical waters, to enclosed seas as well as eastern boundary upwelling and Arctic systems. ICES could also benefit from collaborative marine research taking place in south/south LME twinning e.g. Benguela Current and Humboldt Current eastern boundary upwelling systems. Linking to ecosystem management in tropical waters would pose interesting challenges to ICES. Integrated assessment frameworks and management in EU waters i.e. Baltic Sea LME and North Sea LME also offer ICES good opportunities to learn from these experiences.
- It would be useful if ICES could prepare a briefing document/ spreadsheet outlining what ICES can offer LME so that this could be circulated to LME project directors and managers for feed-back. A similar exercise could be prepared by the LME's for ICES.

b) Indicators

Considerable discussions were held on the types of indicators used in ecosystem assessments and their usefulness.

Those commonly used in LME's to guide management decisions were linked to the five modules and provided information of trends taking place within the systems and regime shifts. Such indicators could be changes in abundance, species composition and geographic range of fish or plankton or increase or reduction in breeding pairs of seabirds or in seal populations. These indicators developed in the TDA process have been very good and specific for each LME and can best be used for communicating outcomes to the public.

The GEF selects various indicators in LME project to monitor successful SAP implementation such as stress reduction, environmental or process indicators. These indicators provide useful guidelines on whether improvements are taking place in the LMEs as a result of integrated management using the ecosystem approach.

In European waters, the use of indicators in integrated ecosystems assessments are more closely linked to the food web and causal chains and the way and how they are used are important in determining changing states of marine ecosystems. Indicators are a complex issue and frameworks have their shortcomings in that they can over-

simplify things. A sound information base is needed to interpret changes taking place in the food web. It is important to know how much indicators reflect reality across ecosystems and to inform decision makers on assessment results and advice.

c) Terms of Reference and Workplan

Following discussions on the terms of reference, it was agreed that the five tasks were too ambitious for the first meeting and should be reviewed and be valid also for next year's WG meeting. The Co-chairs of the Working Group on Large Marine Ecosystem Programme Best Practices (WGLMEBP) in consultation with WG members will address the terms of reference for next year's meeting in a simpler and more focused manner.

The WG meeting in 2011 should address specific aspects of cooperation by ICES in marine science, management and training in LME projects. The development of ecosystem based management frameworks in EU (MSFD) and review indicators now being used for assessing ecosystem status of LMEs.

A concise plan needs to be developed on how ICES would like to interact and strengthen its cooperation with LME network including broader support, sharing of expertise and the provision of a secretariat. More representatives from both ICES and LME projects should be encouraged to attend the next WG.

More discussion should take place on training and capacity building for LMEs and how ICES can assist with this. It would be useful for LMEs to have clarification on what their priority needs are and that these are prepared beforehand and presented in a concise way in a table.

The WG concluded that this first exploratory meeting between ICES and the LME Community of Practice was very successful and offered a lot of opportunities for closer cooperation, formalising links and providing support in marine science, advice and peer review and ecosystem based management.

7 Recommendations

1) It is recommended that a Theme Session on LMEs be developed for the ICES Annual Science Conference in Gdynia, Poland (2011), with Michael O'Toole, Kenneth Sherman and Yvonne Walther as convenors.

2) It is recommended that the WGLMEBP meet in July 2011 at UNECSO HQ, Paris, France back-to-back with and after the 13th LME Consultative Committee Meeting.

3) It is recommended that a short briefing document (with table) be prepared on what ICES and the LME community can offer each other so that these can be circulated before next year's meeting of WGLMEBP.

4) It is recommended that LMEs identify their key priority needs in terms of specialized training courses that ICES could support to address ecosystem based management and assessments.

5) It is recommended to encourage more representatives from LMEs and ICES to attend the next WGLMEBP meeting.

6) It is recommended that the Co-Chairs attend the GEF IW:Science meeting in Oban, Scotland, 15–17 September 2010.

7) It is recommended that the Co-Chairs follow up with developing a work plan for the next two years.

Annex 1: WGLMEBP Draft Resolution 2010

The **Working Group on Large Marine Ecosystem Programme Best Practices** (WGLMEBP), chaired by Michael O'Toole, Ireland, and Jan Thulin, ICES, will meet at UNECSO HQ, Paris, France, July 2011 back-to-back with and after the 13th LME Consultative Committee Meeting to:

a) Continue to identify best practices in the selection of science-based indicators for adaptive ecosystem-based management within the framework of the Large Marine Ecosystem (LME) projects;

b) Further evaluate and compare among LMEs the prescribed principal indicators used to index conditions in relation to resource recovery, climate change, and sustaining socioeconomic benefits;

c) Report findings and methods of best practice in Community of Practice handbooks, publications and reports, including those of the WGLMEBP. These will be made available to LME practitioners, the public and other interested parties in the developing and developed world;

d) Develop effective training modules consistent with effective implemention of best practices for ecosystem-based management at the LME scale;

e) Decide upon terms of reference that relate to a work plan for the next two years, that complement the ICES science plan.

WGLMEBP will report by 15 August 2011 (via SSGRSP) for the attention of SCICOM and ACOM.

Supporting information

Priority	Investments in LME programs in the developing and developed world require implementation plans that are effective and efficient. A critical review of LME principles and implementation success will lead to more effective LME programs resulting in measurable progress in ststaining marine and coastal ecosystems.
Scientific justification	What is presently lacking is a process to identify, review, and synthesize the best assessment and management practices among the community of LME practitioners facilitating the exchange of lessons learned. To date, no effort has been made to analyze and integrate the scientific findings from these projects and to disseminate them to regional and global partners. Additionally, there has been little opportunity to inform LME project scientists and managers about broader global ocean issues, emerging challenges, new methodologies and science and policy breakthroughs in shaping ecosystem-based management. A cross-system comparative analysis would be useful in strengthening the scientific capacity of countries for adaptive ecosystem-based management. The LME projects have reached a level of experience and practice where it is beneficial and cost effective to share experiences, information, technological improvements, measurable benefits, and effective practices and lessons, and direct the information to all project participants. It is critical to provide adaptive management stategies that reflect changing circumstances, in view of the accelerating effects of climate change on marine ecosystems. It is especially important during this economic downturn to maximize available and pertinent LME information in a cost effective way. Given the emphasis on science supporting EBM in the ICES Science Plan, using the past and present LME program outcomes to inform future national and international programs is prudent.

Resource requirements	The LME programs being reviewed by this Working Group are already underway and information necessary for the Working Group to function has already been made available. It is envisioned that LME practioners and selected independent scientists will assist conducting a critical review of best practices in science and governance of LMEs.
Participants	The Group will be attended by some 25-30 members and invited scientists.
Secretariat facilities	Report preparation and dissemination
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the Advisory Committee.
Linkages to other committees or groups	There is a very close working relationship with a number of the working groups under the SCICOM Steering Group on Regional Seas and others
Linkages to other organizations	This Working Group will inform and is endorsed also by the Intergovernmental Oceanographic Commission (IOC), Food and Agricultural Organization (FAO), the United Nationa Environment Program (UNEP), and the Global Environmental Facility (GEF).

Additional Background

1. Introduction:

Overfishing, marine pollution, habitat loss and climate change are contributing to the degradation in the world's marine ecosystems. The net economic benefits provided by coastal oceans are declining even as the coasts become more populated and large segments of the population more dependent on coastal fisheries as their main source of protein. Prompt and large scale changes in the use of ocean resources are needed to overcome the negative consequences of human exploitation.

Beginning in 1995, the Global Environment Facility (GEF) has been providing financial support to developing countries committed to the recovery and sustainability of large marine ecosystems (LMEs) off their coasts. A useful tool in the GEFs arsenal has been a modular indicator-based approach to the assessment and management of LMEs. The comprehensive approach to GEF-funded LME projects has focused on measures of changes in LMEs for (i) productivity, (ii) fish and fisheries, (iii) pollution and ecosystem conditition, (iv) socioeconomics, all enabled through (v) governance. Ecosystem measurements for the first three provide a basis for scientific input into policy and management discussions leading to socioeconomic benefits and mutually agreeable and hopefully effective marine governance regimes. The GEF has provided support for ecosystem projects in one hundred and ten countries (more than half the countries of the globe) in Africa, Asia, Latin America and Eastern Europe to identify root causes of marine ecosystem deterioration and provide guidance for recovery should best management practices be implemented. LME projects in the Benguela Current, Yellow Sea, Guinea Current, Baltic Sea and Agulhas and Somali Currents, are joint initiatives funded by the GEF, the World Bank, and the governments of the participating countries adjacent to the LME. The results of the LME programs in these areas are working toward the management and utilization of the LME resources in a sustainable and integrated manner. The applied and pragmatic LME approach uses 1) science based assessments of LME productivity, fish and fisheries, pollution and ecosystem condition, and (2) linking the science based assessments of the changing states of LMEs to management actions for recovering depleted fisheries, restoring critical habitats assesses and managing large ocean areas for sustained biological productivity.

2. Issue to be addressed:

What is presently lacking is a process to identify, review, and synthesize the best assessment and management practices among the community of LME practitioners facilitating the exchange of lessons learned. To date, no effort has been made to analyze and integrate the scientific findings from these projects and to disseminate them to regional and global partners. Additionally, there has been little opportunity to inform LME project scientists and managers about broader global ocean issues, emerging challenges, new methodologies and science and policy breakthroughs in shaping ecosystem-based management. A cross-system comparative analysis would be useful in strengthening the scientific capacity of countries for adaptive ecosystem-based management. The LME projects have reached a level of experience and practice where it is beneficial and cost effective to share experiences, information, technological improvements, measurable benefits, and effective practices and lessons, and direct the information to all project participants. It is critical to provide adaptive

management stategies that reflect changing circumstances, in view of the accelerating effects of climate change on marine ecosystems. It is especially important during this economic downturn to maximize available and pertinent LME information in a cost effective way. Given the emphasis on science supporting EBM in the ICES Science Plan, using the past and present LME program outcomes to inform future national and international programs is prudent.

Establishment of a new ICES Large Marine Ecosystem Community of Practice Working Group (WG-LME).

The objective of the working group would be the sharing of information (e.g., data, lessons learned and best managment practices) developed through the LME project process among the the global marine science community.

ICES has a long and successful history in the coordination and promotion of marine research in oceanography, the marine environment, marine ecosystems, and living marine resources in the North Atlantic. This Working Group would utilize the extensive ICES scientific network to gather additional information about marine ecosystems, filling gaps in existing knowledge and providing information and unbiased, non-political advice as it related to LMEs around the world. Given the global nature of the GEF-funded LME work, it may be possible for ICES to enlist other international marine science organizations such as PICES and IOC in a joint working group setting, and this should be explored.

Annex 2: WGLMEBP Terms of Reference 2009

The **Working Group on Large Marine Ecosystem Programme Best Practices** (WGLMEBP), chaired by Michael O'Toole, Ireland, and Jan Thulin, ICES, will be established and will meet in Paris, France, 6–7 July 2010 to:

a) To identify best practices in the selection of science-based indicators for adaptive ecosystem-based management within the framework of the Large Marine Ecosystem (LME) projects;

b) To evaluate and compare among LMEs the prescribed principal indicators used to index conditions in relation to resource recovery, climate change, and sustaining socioeconomic benefits;

c) To report findings and methods of best practice in Community of Practice handbooks, publications and reports, including those of the WG-LME-BP. These will be made available to LME practitioners, the public and other interested parties in the developing and developed world;

d) To develop effective training modules consistent with effective implemention of best practices for ecosystem-based management at the LME scale;

e) Draw up terms of reference that relate to a work plan for the next three years, that complement the ICES science plan.

WGLMEBP will report by 16 August 2010 (via SSGRSP) for the attention of SCICOM and ACOM.

Annex 3: List of participants

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Annex 4: Agenda

DAY 1 – Tuesday, 6 July

9:00–9:05 Welcome on behalf of ICES: Gerd Hubold

9:05–9:25 Introduction and Background to ICES LME Working Group: Co-Chairs Michael O'Toole and Jan Thulin; Moderator: Gerd Hubold

9:25–9:45 Assessment and Management Methodology and Best Practices with a Focus on Indicators: Kenneth Sherman

9:45–10:00 Meeting Marine Research and Ecosystem-based Management Needs in LMEs Worldwide: Gotthilf Hempel

10:00–10:20 The Benguela Current LME: Michael O'Toole and Hashali Hamukuaya

10:20–10:40 Tea / Coffee

10:40–11:00 The Baltic Sea LME: Jan Thulin

11:00–11:20 The Guinea Current LME: Stephen Maxwell Donker

11:20–11:40 The Gulf of Mexico LME : Antonio Diaz de Leon

11:40–12:00 The Agulhas Somali Current LME : David Vousden

12:00–12:20 The Barents Sea LME: Hein Rune Skjoldal

12:20 – 12:40 ICES Scientific Network & Expertise: Ecosystem Approach to Fisheries & Marine Environmental Management – Applications to LMEs: Adi Kellermann

12:40–14:00 Lunch

Moderator: Gotthilf Hempel

14:00–14:20 Synthesis of the GEF IW LME projects: emerging science issues, indicators and adaptative management: Sheila Heymans

14:20–14:40 Training and Capacity Building in the Benguela Current LME: Hashali Hamukuaya

14:40–15:00 Training in African LME's, particularly the Aghulas-Somali Current LME: David Vousden

15:00–15:20 Coordinating LME Best Practice Information and Outreach: (Marie-Christine Aquarone) Ken Sherman

15:20–15:40 Tea / Coffee

15:40–16:00 IW:LEARN in relation to LME projects: Vladimir Mamaev

16:00–16:20 Training in Asian LMEs including Yellow Sea: Yihang Jiang

16:20–16:40 Training in Latin American LMEs including Gulf of Mexico and Caribbean Sea LME: Antonio Diaz de Leon

16:40–17:40 Plenary Session: Opportunities for LME Scientists to Interact with ICES Scientists on Best Practices Methodologies: To be chaired by Gerd Hubold or Adi Kellermann

17:40–18:00 Review of Day 1 and Planning for Day 2: Michael O'Toole

18:00 Adjourn

DAY 2 – Wednesday, 7 July

09:00–09:15 Guidelines and Protocols for Producing ICES Reports: Jan Thulin and Michael O'Toole

09:15–11:00 Discussion Session 1: Best Practices in regard to Indicators for Productivity, Fish and Fisheries, Pollution and Ecosystem health, Socio-economics and Governance: Leader: Jan Thulin

11:00–11:15 Tea / Coffee

11:15–12:15 Discussion Session 2: The Relationship of Indicators to Resource Recovery, Climate Change and Sustaining Socio preferred -economic Benefits: Leader Michael O'Toole /Rapporteur Sheila Heymans

12:15–13:15 Lunch

13:15–15:15 Report Writing, Recommendations and Resolutions

Group 1: Prepare the Structure for a Draft Report on the Working Group Findings: Jan Thulin

Group 2: Prepare the Structure of a Draft Report on the Working Group

Methodologies and Resolutions: Michael O'Toole

Group 3: Prepare the Structure of a Draft Work Plan for the Next Three Years

Marie-Christine Aquarone

15:15–15:30 Tea / Coffee

15:30–16:30 Final Plenary Session: Report Back on the Key Elements of Writing Groups: Jan Thulin, Michael O'Toole and Marie-Christine Aquarone

16:30 Close

Annex 5: Recommendations

Recommendation	For follow up by:
1. It is recommended that a Theme Session on LMEs be developed for the ICES Annual Science Conference in Gdynia, Poland (2011), with Michael O'Toole, Kenneth Sherman and Yvonne Walther as convenors.	TS Convenors
2. It is recommended that the WGLME meet in July 2011 at UNECSO HQ, Paris, France back-to-back with and after the 13th LME Consultative Committee Meeting.	SCICOM
3. It is recommended that a short briefing document (with table) be prepared on what ICES and the LME community can offer each other so that these can be circulated before next year's meeting of WGLME.	WGLMEBP
4. It is recommended that LMEs identify their key priority needs in terms of specialized training courses that ICES could support to address ecosystem based management and assessments.	WGLMEBP/ LMEs
5. It is recommended to encourage more representatives from LMEs and ICES to attend the next WGLME meeting.	ICES/ LMEs
6. It is recommended that the Co-Chairs attend the GEF IW:Science meeting in Oban, Scotland, 15–17 September 2010.	WGLMEBP Co-chairs
7. It is recommended that the Co-Chairs follow up with developing a proposal for a work plan for the next two years.	WGLMEBP Co-chairs